[0149] In equation (55) the sum of all column/row products equals the identity matrix, which implies that the sum of all modes except for mode s_1 is the identity matrix subtracted by the matrix associated with mode s_1:

$$I_{TWdiff}\Big|_{t\geq\tau_{s_1B}} \approx \left(\begin{bmatrix}1 & 0 & \dots & 0\\ 0 & 1 & \dots & 0\\ \vdots & \vdots & \ddots & \vdots\\ 0 & 0 & \dots & 1\end{bmatrix} - \begin{bmatrix}A_{1s_1}\\ A_{2s_1}\\ \vdots\\ A_{ns_1}\end{bmatrix}[B_{s_1 1}\ \ B_{s_1 2}\ \ \dots\ \ B_{s_1 n}] + H_{l_B}^{\prime ms_1}(s)\begin{bmatrix}A_{1s_1}\\ A_{2s_1}\\ \vdots\\ A_{ns_1}\end{bmatrix}[B_{s_1 1}\ \ B_{s_1 2}\ \ \dots\ \ B_{s_1 n}]\right) I_F\cdot e^{-S\tau_{s_1B}} \tag{56}$$

[0150] Expansion of the multiplication in equation (56) yields:

$$I_{TWdiff}\Big|_{t\geq\tau_{s_1B}} \approx \left(\begin{bmatrix}1-A_{1s_1}B_{s_1 1} & -A_{1s_1}B_{s_1 2} & \dots & -A_{1s_1}B_{s_1 n}\\ -A_{2s_1}B_{s_1 1} & 1-A_{2s_1}B_{s_1 2} & \dots & -A_{2s_1}B_{s_1 n}\\ \vdots & \vdots & \ddots & \vdots\\ -A_{ns_1}B_{s_1 1} & -A_{ns_1}B_{s_1 2} & \dots & 1-A_{ns_1}B_{s_1 n}\end{bmatrix} + H_{l_B}^{\prime ms_1}(s)\begin{bmatrix}A_{1s_1}B_{s_1 1} & A_{1s_1}B_{s_1 2} & \dots & A_{1s_1}B_{s_1 n}\\ A_{2s_1}B_{s_1 1} & A_{2s_1}B_{s_1 2} & \dots & A_{2s_1}B_{s_1 n}\\ \vdots & \vdots & \ddots & \vdots\\ A_{ns_1}B_{s_1 1} & A_{ns_1}B_{s_1 2} & \dots & A_{ns_1}B_{s_1 n}\end{bmatrix}\right) I_F\cdot e^{-s\tau_{s_1B}} \tag{57}$$

[0151] Since the modes will appear in reversed order in the normalized differential current $\hat{I}_{TWdiff}$, the first mode s_1 will appear at $t=\tau_{s1B}$, i.e. at the same time as for the 'original' differential current. Before $t=\tau_{s1B}$, all elements in $\hat{I}_{TWdiff}$ will be zero. In the time interval between the arrival of slowest mode ($t=\tau_{s1B}$) and the second (next) slowest mode ($t=\tau_{s2B}+\tau_{s1}-\tau_{s2}$), $\hat{I}_{TWdiff}$ can be expressed as:

$$\hat{I}_{TWdiff}\big|_{\tau_{s_1B}\leq t<\tau_{s_2B}+\tau_{s_1}-\tau_{s2}} = \left(H_{l_B}^{\prime ms_1}(s)\begin{bmatrix}A_{1s_1}\\ A_{2s_1}\\ \vdots\\ A_{ns_1}\end{bmatrix}[B_{s_1 1}\ \ B_{s_1 2}\ \ \dots\ \ B_{s_1 n}]\right) I_F\cdot e^{-s\tau_{s_1B}} \tag{58}$$

[0152] Expansion of equation (58) yields:

$$\hat{I}_{TWdiff}\big|_{\tau_{s_1B}\leq t<\tau_{s_2B}+\tau_{s_1}-\tau_{s2}} = \left(H_{l_B}^{\prime ms_1}(s)\begin{bmatrix}A_{1s_1}B_{s_1 1} & A_{1s_1}B_{s_1 2} & \dots & A_{1s_1}B_{s_1 n}\\ A_{2s_1}B_{s_1 1} & A_{2s_1}B_{s_1 2} & \dots & A_{2s_1}B_{s_1 n}\\ \vdots & \vdots & \ddots & \vdots\\ A_{ns_1}B_{s_1 1} & A_{ns_1}B_{s_1 2} & \dots & A_{ns_1}B_{s_1 n}\end{bmatrix}\right) I_F\cdot e^{-s\tau_{s_1B}} \tag{59}$$

[0153] Comparing the left-hand side matrix in equation (57) with the matrix in equation (59), it can be noted that all off-diagonal elements are equal but have different signs in the two equations. This implies that any false differential current will appear in $\hat{I}_{TWdiff}$ as well during faults at $0<l_B<1$, but that it however will appear with opposite sign as compared to a false differential current appearing in I_{TWdiff}. The false differential current appearing in I_{TWdiff} will start to decrease towards zero with the same or substantially the same time constant as the false differential current appearing in $\hat{I}_{TWdiff}$ starts to appear. During this time, all false differential currents will have opposite polarities in I_{TWdiff} and $\hat{I}_{TWdiff}$, respectively. A product of two quantities with opposite polarities will be negative, while a product of two quantities of the same polarity—either positive or negative—will be positive. This allows for a false differential current in M_{TWdiff} to be eliminated by discarding all negative products therein. Limiting the elements in M_{TWdiff} to only those with positive values or those being zero, and calculating the square root of each element yields:

$$C_{TWdiff}=\max(0,M_{TWdiff}) \tag{60}$$

[0154] The term within the square root in equation (60) is limited to positive values, ande hence evaluation of the square root does not yield an imaginary result.

[0155] Hence, for faults that may occur either at or substantially at $l_B=0$ or $l_B=1$, an element-bye-element product of vectors I_{TWdiff} and $\hat{I}_{TWdiff}$ may eliminate any false differential current, since in case of a false differential current appearing in an element in one of the respective vectors the corresponding element in the other one of the respective vectors will be zero or substantially zero. However, for a fault that may occur at an arbitrary point or location along the transmission line, such as for example substantially in the middle of the transmission line, false differential currents for corresponding elements may appear in both of the vectors I_{TWdiff} and $\hat{I}_{TWdiff}$. However, as described above, for faults that may occur at such locations along the transmission line, modal components may arrive in opposite order in I_{TWdiff} as compared to $\hat{I}_{TWdiff}$. The first modal component to appear in $\hat{I}_{TWdiff}$ will in general be the slowest mode, s_1. Due to properties of the columns in the transformation matrix T_i and the rows of its inverse T_i^{-1}, any false differential currents will initially appear with opposite signs in the two vectors I_{TWdiff} and $\hat{I}_{TWdiff}$. A product of two elements with opposite signs will be negative, which means that if all negative values are discarded after the element-by-element multiplication of I_{TWdiff} and $\hat{I}_{TWdiff}$, or limiting the elements in the resulting vector to those having values greater than or equal to zero, any false differential current may be eliminated for faults that may occur at an arbitrary location along the transmission line, $0\leq l_B\leq 1$.